

## Statistical Reasoning Recommended Competencies

| Recommended Competencies  | Student Learning Outcomes   |
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| The Corequisite at Scale Task Force offers the following <u>possible</u> topics of study for a statistical reasoning, corequisite course. These topics include just-in-time learning of foundational skills and review of credit-bearing, course content. Instruction on the efficient use of technology and study skills are also advised. | The Missouri Math Pathways Task Force has determined the following Student Learning Outcomes as the minimum requirements of a credit-bearing, entry-level, college course in statistical reasoning. |

| <b>I. Data Exploration</b><br><br><b>Students will analyze data using graphical and numerical methods to study patterns and departures from patterns, using appropriate technology as needed. Specifically, students will be able to:</b>                                     |   |
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| <b>Construct and interpret graphical displays of distributions of univariate data.</b>  |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>Plot points and intervals on a number line</li> <li>Perform signed number arithmetic</li> <li>Read to understand information from tables and graphs</li> </ul>   | <ul style="list-style-type: none"> <li>Create and interpret dotplots, boxplots, stem and leaf plots and histograms.</li> <li>Analyze center, shape and spread, as well as clusters, gaps, outliers and other unusual features.</li> </ul>   |
| <b>Summarize distributions of univariate data and compare multiple distributions.</b>   |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>Use summation notation</li> <li>Plot an ordered pair (x, y) in a rectangular coordinate system</li> <li>Round decimal values</li> <li>Understand powers and square roots of numbers</li> <li>Understand order of operations</li> </ul> | <ul style="list-style-type: none"> <li>Compute measures of center (median, mean), measures of spread (range, interquartile range, standard deviation) and measures of position (quartiles, other percentiles and standardized scores).</li> <li>Compare groups using back-to-back stem and leaf plots, parallel boxplots and dotplots.</li> </ul> |
| <b>Explore bivariate data.</b>  |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>Find the slope of line segment connecting two points, the equation of a line, and graph the equation of a line</li> <li>Find the vertical distance between a point and a line</li> <li>Round decimal values</li> </ul>                 | <ul style="list-style-type: none"> <li>Analyze scatterplots for patterns, linearity, and outliers.</li> <li>Calculate and interpret the correlation coefficient.</li> </ul>   |

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| <b>I. Data Exploration (continued)</b>  |   |
| <b>Students will analyze data using graphical and numerical methods to study patterns and departures from patterns, using appropriate technology as needed. Specifically, students will be able to:</b> |   |
| <b>Explore categorical data.</b>  |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>• Read to understand information from a table or a graph</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Create and interpret frequency tables and bar charts.</li> <li>▪ Compare distributions of categorical data.</li> </ul> |

  

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| <b>II. Statistical Design</b>   |   |
| <b>Students will critically evaluate a data-collection plan to answer a given research question. Specifically, students will be able to:</b>  |   |
| <b>Identify characteristics of good study designs. Understand what conclusions are appropriate for a given design and whether conclusions can be generalized to a larger population.</b>                    |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>• Read carefully through a problem</li> <li>• Know and understand key terms</li> <li>• Read carefully to identify important information in a word problem</li> </ul> | <ul style="list-style-type: none"> <li>▪ Identify the population of interest.</li> <li>▪ Determine whether an observational or experimental study is appropriate and feasible.</li> <li>▪ Explain the difference between and importance of random selection and random assignment in study design.</li> </ul> |
| <b>Know the elements of planning and conducting an observational study.</b>   |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>• Distinguish between a sample and a population</li> <li>• Differentiate between key terms</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Verify basic elements of statistically valid sample survey.</li> <li>▪ Determine when a census or a sample survey is appropriate.</li> <li>▪ Identify potential sources of bias in sampling and surveys.</li> </ul>  |
| <b>Know the elements of planning and conducting an experimental study.</b>  |   |
| <i>Possible Corequisite Topics</i>  | <i>Pathways Initiative Student Learning Outcomes</i>  |
| <ul style="list-style-type: none"> <li>• Recognize and differentiate between key terms</li> <li>• Identify dependent and independent variables</li> </ul>   | <ul style="list-style-type: none"> <li>▪ Verify basic elements of statistically valid experimental design.</li> <li>▪ Explain the purpose of including a control group and blinding in an experiment.</li> <li>▪ Identify potential sources of confounding in an experiment.</li> </ul>                       |

| III. Probability and Simulation  |  |
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| Students will use probability concepts and simulation. Specifically, students will be able to:   |  |
| <b>Determine and interpret probabilities.</b>  |  |
| <i>Possible Corequisite Topics</i>   | <i>Pathways Initiative Student Learning Outcomes</i>   |
| <ul style="list-style-type: none"> <li>• Convert among fractions, decimals, and percents</li> <li>• Operate with fractions</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Interpret a probability as a long-run relative frequency of occurrence.</li> <li>▪ Calculate the probability of a specified event in a chance experiment with equally likely outcomes.</li> </ul>   |
| <b>Use probability distributions to describe the behavior of discrete and continuous random variables.</b>   |  |
| <i>Possible Corequisite Topics</i>   | <i>Pathways Initiative Student Learning Outcomes</i>   |
| <ul style="list-style-type: none"> <li>• Decide upon appropriate units of measurement in collection data</li> <li>• Perform signed number arithmetic</li> <li>• Plot numbers on a real number line, find a mean value and a range</li> <li>• Represent an inequality as an interval on the number line</li> <li>• Shade an area under the normal distribution</li> </ul> | <ul style="list-style-type: none"> <li>▪ Distinguish between discrete random variables and continuous random variables.</li> <li>▪ Compute and interpret the mean and standard deviation of the probability distribution of a discrete random variable.</li> <li>▪ Demonstrate an understanding of the mean, standard deviation and shape of continuous probability distributions (uniform, normal and skewed).</li> </ul> |
| <b>Understand distributions.</b>   |  |
| <i>Possible Corequisite Topics</i>   | <i>Pathways Initiative Student Learning Outcomes</i>   |
| <ul style="list-style-type: none"> <li>• Recognize and differentiate between key terms</li> </ul>  | <ul style="list-style-type: none"> <li>▪ Distinguish between the distribution of a sample and a sampling distribution.</li> <li>▪ Describe the sampling distributions of a sample mean and sample proportion in terms of center, shape and spread.</li> <li>▪ Explain how these relate to sample size.</li> <li>▪ Identify when the use of the normal distribution is appropriate.</li> </ul>                              |

| IV. Statistical Inference   |   |
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| Students will use statistical models to draw conclusions from data. Specifically, students will be able to:   |   |
| Estimate population parameters including confidence intervals when appropriate.   |   |
| Possible Corequisite Topics   | Pathways Initiative Student Learning Outcomes   |
| <ul style="list-style-type: none"> <li>Understand order of operations</li> <li>Realize properties of inequalities</li> </ul>  | <ul style="list-style-type: none"> <li>Verify that the appropriate conditions have been met.</li> <li>Construct one-sample confidence intervals for means and for proportions.</li> <li>Construct two-sample confidence intervals for means.</li> <li>Interpret confidence intervals in context and explain the meaning of the confidence level associated with a confidence interval estimate.</li> </ul>  |
| Conduct tests of significance when appropriate.   |   |
| Possible Corequisite Topics   | Pathways Initiative Student Learning Outcomes   |
| <ul style="list-style-type: none"> <li>Understand order of operations</li> <li>Represent an inequality as an interval on the number line</li> <li>Interpret probability</li> <li>Use function notation</li> </ul> | <ul style="list-style-type: none"> <li>Verify that the appropriate conditions have been met.</li> <li>Carry out one-sample hypothesis tests for means and proportions.</li> <li>Carry out two-sample hypothesis tests for means.</li> <li>Interpret the meaning of rejection of the null hypothesis and of failure to reject the null hypothesis, in context.</li> <li>Demonstrate an understanding of the use of a p-value to reach a conclusion and of the difference between practical significance and statistical significance.</li> </ul> |

| V. Regression Modeling  |   |
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| Possible Corequisite Topics   | Pathways Initiative Student Learning Outcomes   |
| <ul style="list-style-type: none"> <li>Find the slope of line segment connecting two points, the equation of a line, and graph the equation of a line</li> <li>Understand slope as a ratio of change</li> </ul> | <ul style="list-style-type: none"> <li>Determine the equation of the least-squares regression line and interpret its slope and intercept in context.</li> </ul> |